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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/669,063	09/23/2003	Mohamad A. Shaheen	42P15990	2742

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EXAMINER

TRAN, BINH X

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 05/30/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/669,063

Applicant(s)

SHAHEEN, MOHAMAD A.

Examiner

Binh X. Tran

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 19 April 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-29 is/are pending in the application.
- 4a) Of the above claim(s) 15-20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-14 and 21-29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 4-19-2006 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-3, 8-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Thilderkvist et al. (US EP 1085562 A2) in view of Malik et al. (US 2004/0067644).

Respect to claim 1, Thilderkvist discloses a method comprising the steps of:
forming a silicon germanium layer on the substrate (paragraph 0033, 0045);
removing, in the processing chamber, a portion of silicon germanium layer
(exposing to first etchant gas) (See paragraph 0048-0049, col. 18 lines 38-43);
smooth a surface of silicon germanium layer in the processing chamber
(paragraph 0050, col. 18 lines 43-50);

forming a silicon layer on the smooth surface of the silicon germanium layer (Figure 1 step 108, paragraph 0053, 0068).

Thilderkvist fails to disclose that the silicon germanium is also formed in the same processing chamber. In a method for forming silicon germanium, Malik teaches to grow and etch the silicon germanium in the same process chamber (See Fig 2, paragraph 0037). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Thilderkvist in view of Malik by forming silicon germanium in the same process chamber because it will improve the efficiency and cost of the process.

Respect to claim 2, Thilderkvist teaches the substrate is not removed from the processing chamber until after the silicon layer is formed (Fig 1). Respect to claim 3, Thilderkvist teaches to keep the chamber under vacuum by using a pump to create reduced pressure during the removal of a portion of silicon germanium layer until after the completion of formation of the silicon layer (paragraph 0032).

Respect to claims 8-9, Thilderkvist teaches to use HCl or HBr etchant to remove silicon germanium layer. Malik also teaches to use HCl or HBr etchant to remove silicon germanium (paragraph 0035).

Respect to claim 10, Thilderkvist teaches to use either silicon or silicon germanium film (paragraph 0045). Thilderkvist further teaches the removal amount of this film is about 100 nm (paragraph 0050; Note 100 nm = 0.1 micron). Respect to claim 11, Thilderkvist teaches the smooth a surface of the silicon germanium wherein the smooth comprises introducing a smoothing agent (col. 11 lines 5-10, col. 18 lines

38-52). Respect to claims 12-13, Thilderkvist teaches to use hydrogen smooth agent at the temperature between 1000-1300 °C, preferably between 1050-1200 ° C, 1100 °C to smooth the silicon germanium surface (abstract and paragraph 0045, 0047, 0050).

Respect to claim 14, Thilderkvist fails to explicitly disclose the specific thickness ranges for the silicon layer. However, Thilderkvist clearly teaches the silicon film can be formed having any thickness (paragraph 0053). The result effective variable is commonly determined by routine experiment. Thickness is a result effective variable. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the time of invention, to perform routine experiment to obtain optimal thickness as an expected result.

4. Claims 4-7, 21-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Thilderkvist and Malik, and further in view of Leitz et al. (US 2002/0197803).

Respect to claims 4 and 21, Thilderkvist and Malik fail to disclose forming a first layer of silicon germanium having an increasing concentration of germanium and a second layer of silicon germanium having a constant concentration of germanium. Leitz discloses the step of: forming a first layer of silicon germanium (12) on a silicon substrate, wherein the first layer (12) has an increase in concentration of germanium with respect to one direction from the substrate (paragraph 0030), forming a second layer (14) of silicon germanium on the first layer (12) of silicon germanium, wherein the second layer has a constant concentration of germanium throughout a thickness of the second layer (paragraph 0030, Fig 1). It would have been obvious to one having

Art Unit: 1765

ordinary skill in the art, at the time of invention, to form two different silicon germanium layers and etching the second layer because it will enhance the performance of the hetero-structure device by using silicon germanium as carrier mobility.

The limitation of claims 22-23 has been discussed above under Thilderkvist's reference. Respect to claims 5 and 24, Leitz teaches to increase the concentration of germanium in the first layer so that the concentration of germanium increases by 10% per micron of the thickness (paragraph 0030).

Respect to claims 6 and 25, Leitz discloses that the concentration of the second layer (14) is 20%. Leitz also teaches first layer has a thickness of 2-9 micron and the concentration increase by 10% per micron. When the thickness of the first layer equals to 2 micron, the concentration in the upper portion of the first layer would be 20% (10 % per micron x 2 micron = 20%). Base on this information, the concentration of germanium in the second layer is the same as the concentration of the first layer in the upper portion.

Respect to claim 7, Leitz teaches the second layer is formed to a thickness between 0.2-2 μm (paragraph 0030, overlap with applicant's range). Respect to claims 26-27, Thilderkvist and Malik teaches to use the HCl or HBr etchant to remove silicon germanium layer.

Respect to claim 28, Thilderkvist teaches the smooth a surface of the silicon germanium wherein the smooth comprises introducing a smoothing agent (col. 11 lines 5-10, col. 18 lines 38-52). Respect to claim 29, Thilderkvist teaches to use hydrogen smooth agent

Response to Arguments

5. The applicants argue that the references Thilderkvist do not teach or suggest “removing a portion of the silicon germanium layer in the processing chamber, and following removing, smooth a surface of the silicon germanium layer in the process chamber as required by amended claims 1 and 21”. The examiner strongly disagrees. In col. 18 lines 38-52 and paragraph 0050, Thilderkvist teaches exposing the silicon germanium (i.e. silicon alloy) to the first etching to remove a portion of the silicon germanium at a high etch rate, and a second etching to smooth the surface of the silicon germanium at a low etch rate. Thus, the examiner interprets that Thilderkvist teaches removing a portion of the silicon germanium layer in the processing chamber, and following removing, smooth a surface of the silicon germanium layer in the process chamber.

The applicants further argue that Thilderkvist teaches against forming in the same processing chamber that used to remove and smooth. The examiner disagrees. The examiner clearly recognizes that Thilderkvist fails to disclose forming silicon germanium layer in the same processing chamber as removing and smoothing. However, teaching one way does not mean teaching away. The new cited prior art Malik clearly teaches to form silicon germanium in the same processing chamber for removing/smooth the silicon germanium surface (See Fig 2). Malik further discloses the advantage of using the same processing chamber because it will improve the efficiency and the cost of the process (paragraph 0037). Based on this reason, the examiner

concludes that it is obvious to modify Thilderkvist in view of Malik by using the same processing chamber.

Conclusion

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Binh X. Tran whose telephone number is (571) 272-1469. The examiner can normally be reached on Monday-Thursday and every other Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000..

Binh Tran

Binh X. Tran